

*Way Gull*  
civilian act  
OCD 2202-1  
January 1943

# FIRST AID

*in the Prevention  
and Treatment of*

# CHEMICAL CASUALTIES

*Revised*



**MEDICAL DIVISION**  
**U.S. OFFICE OF CIVILIAN DEFENSE**  
**Washington, D. C.**

AUG 13 '43



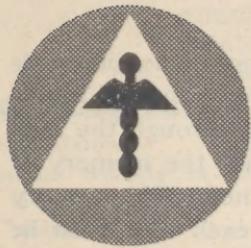
# PREFACE

This booklet is intended for the personnel of Emergency Medical Field Units and others who may be immediately concerned in the cleansing of persons and the administration of first aid to chemical casualties. Identification, characteristics, and tactical uses of the various agents are discussed only briefly; the reader is referred to the Civilian Defense textbook, "Protection Against Gas," for a more extensive discussion of these matters. For information on medical care and treatment consult Technical Manual 8-285, "Treatment of Casualties from Chemical Agents," prepared by the War Department and published by the Government Printing Office.

## CONTENTS

<i>Chapter</i>		<i>Page</i>
<b>I. General Considerations</b>		3
A. Kinds		3
B. Recognition		3
1. Identification by Odor		4
2. Table of Odors and Effects		4
C. General Protective Measures		5
<b>II. Lung Irritants (Phosgene, Chloropicrin, Chlorine, Nitric Fumes)</b>		6
A. Latent Period		6
B. Effects		6
C. Symptoms		7
D. First Aid		7
<b>III. Blister Gases (Mustard, Lewisite, Ethyldichlorarsine)</b>		8
A. Special Characteristics		8
Table of Differences between Lewisite and Mustard		10
B. Mustard		11
1. Effects		11
2. Prevention—First Aid		12
C. Lewisite		14
1. Early Effects		15
2. Late Effects		15
3. Prevention—First Aid		15
D. Ethyldichlorarsine		16
1. Immediate Effects		16
2. First Aid		16

<b>IV. Tear Gases</b> (Lacrimators) (Chloracetophenone, Chloracetophenone Solution, C N B Solution, Brombenzylcyanide)	17
A. Effects	17
B. First Aid	17
<b>V. The Irritant Smokes</b> (Sneeze Gases or Sternutators) (Adamsite, Diphenylchlorarsine)	18
A. Effects	18
B. Diagnosis	18
C. First Aid	18
<b>VI. Incendiaries</b> (Thermit—molten or burning metal, Oil, White Phosphorus)	19
A. Thermit and Oil	19
B. White Phosphorus	19
First Aid	19
<b>VII. The Screening Smokes</b> (Titanium Tetrachloride, HC Mixture, Sulfur Trioxide-chlorsulfonic Acid Solution, White Phosphorus)	20
A. Titanium Tetrachloride, HC Mixture, and Sulfur Trioxide-Solutions	20
First Aid	20
B. White Phosphorus	20
<b>VIII. The Systemic Poisons</b> (Hydrocyanic Acid and Hydrogen Sulfide, Arsine, Carbon Monoxide)	21
A. Hydrocyanic Acid and Hydrogen Sulfide	21
1. Immediate Effects	21
2. First Aid	21
B. Arsine	22
C. Carbon Monoxide	22
1. Effects	22
2. First Aid	22
<b>IX. Gas Cleansing Stations</b>	23
Steps in Cleansing	23
<b>Addendum</b> —Nitrogen Mustards	25
<b>Appendix I</b> How to Protect Yourself Against Gas	25
<b>Appendix II</b> Recommended Contents of Special First Aid Chest for Gas Casualties—Uses of Recommended Agents	27
<b>LIST OF ILLUSTRATIONS</b>	
Figure A.—Blister following liquid mustard	13
Figure B.—Same as Figure A after two weeks	13
Figure C.—Diagram of gas cleansing station suggesting a suitable arrangement of facilities	24



# FIRST AID *in the Prevention and Treatment of CHEMICAL CASUALTIES*

## **CHAPTER I—GENERAL CONSIDERATIONS**

There is always a possibility in modern warfare that chemical agents may be used against unprotected civilian populations. Information on prevention and treatment of casualties from these agents should be disseminated widely, so that the population may be properly protected. Some of the agents with the most unpleasant and severe immediate effects do not cause permanent injury; proper precautions will prevent casualties from the more insidious and dangerous agents. Speed in applying protective measures is important; treatment immediately after exposure is more beneficial than anything that can be done later, after signs of injury appear.

### **A. Kinds**

Chemical warfare agents are classified according to their effects. Substances of widely different chemical composition may fall in the same group because their action on the human body is similar:

1. Lung Irritants
2. Blister Gases
3. Tear Gases
4. Irritant Smokes (Sneeze Gases)
5. Incendiaries
6. Screening Smokes
7. Systemic (Internal) Poisons

### **B. Recognition**

For his own protection, every individual should learn to recognize the odors of chemical agents. The trained individual must recognize them in order also to protect a disabled person in his care. "Sniff Sets" have been prepared by the Chemical Warfare Service for use in familiarizing students with the various odors. Care must be taken in unstoppering sample bottles; heat may cause pressure enough to blow the cork out and spatter the user.

## **1. Identification by Odor**

Do not smoke during the test of odors—smoking dulls the sense of smell. Sniff lightly only once. Do not inhale and after each test, breathe out strongly through the nose several times. Allow a little time so that the memory of one sample will not be confused with another. The memory of odors can be trained by practice, and each odor must be associated with a name. Remember that the enemy may mix chemical agents to cause confusion, and that more than one gas may be used during an attack.

## **2. Table of Odors and Effects**

	CHEMICAL WARFARE SYMBOL	ODOR	OTHER IMMEDIATE EFFECTS
<b>Lung Irritants</b>			
Phosgene	CG	Silage; fresh-cut hay	Coughing; tightness in chest; eye irritation.
Chloropicrin	PS	Sweetish; flypaper	Tears; nose and throat irritation; vomiting.
Chlorine	CL	Disagreeable; like bleaching powder	Choking; coughing; pain in chest; smarting eyes.
Nitric fumes	—	Pungent	Coughing; brown stain.
<b>Blister Gases</b>			
Mustard	HS	Garlic; horseradish	None.
Lewisite	M-1	Geraniums	Smarting skin; burning eyes
Ethyldichlorarsine	ED	Biting	Nasal irritation.
<b>Tear Gases</b>			
Chloracetophenone (also solution)	CN	Locust or apple blossoms; fruity	Flow of tears; irritation of skin.
CNB solution		Tire patching cement	Flow of tears.
Brombenzylcyanide	CA	Sour fruit	Flow of tears; nasal irritation.
<b>Irritant Smokes (Sneeze Gases)</b>			
Adamsite	DM	None	Headache; vomiting; mental depression.
Diphenylchloro- arsine	DA	None	Sneezing; vomiting; headache.
<b>Incendiaries</b>			
White phosphorus (also used as screening smoke)	WP	Matches	Burns; glow from particles.

CHEMICAL WARFARE SYMBOL	ODOR	OTHER IMMEDIATE EFFECTS
<b>Screening Smokes</b>		
HC mixture	HC	Arid
Sulfur trioxide in chlorsulfonic acid.	FS	Arid (strong)
Titanium tetrachloride	FM	Arid (mild)
<b>Systemic (Internal) Poisons</b>		
Hydrocyanic acid	—	Bitter almonds
Arsine	—	Garlic; metallic taste
Hydrogen sulfide	—	Rotten eggs
Carbon monoxide	—	None

## C. General Protective Measures

Civilian protection personnel who must remain on the street will need gas masks for proper individual protection. Such masks will not, however, protect against carbon monoxide, ammonia, or oxygen-deficient atmospheres and are, therefore, not suitable for use in fighting fires or in industrial accidents where ammonia fumes are present. It is important for civilian protection personnel to learn by practice how to put on and adjust the mask quickly.

The amount of agent in the air (the concentration) determines the intensity and rapidity of the effects produced. The higher the concentration, the shorter is the period of exposure required to produce a casualty.

Get out of the contaminated atmosphere or area as soon as possible. Gases tend to travel downwind. If gas has been released in your immediate vicinity by bomb explosion or spray, move upwind. If gas has been released upwind from you, move across the wind till you are out of the stream.

Most agents are heavier than air and tend to settle in hollows. Therefore, avoid low places or basements. The second story of a building is relatively safe. Close doors and windows, stuffing cracks and chimney; this will keep gas out for hours. If windows are blown out by explosions, hang wet blankets over openings to keep gas from blowing in. The blankets should be fastened tight at the edges.

## **CHAPTER II—LUNG IRRITANTS**

### **Phosgene (CG) Chlorpicrin (PS) Chlorine (CL) Nitric fumes**

All chemical warfare agents may act as lung irritants under certain circumstances, but with phosgene, chlorpicrin, chlorine, and nitric fumes, lung irritation is the most conspicuous effect. Nitric fumes have not been used directly in an attack, but are one of the gaseous products of nitrate explosives. Rescue Unit workers and others required to enter poorly ventilated buildings or tunnels following explosions may be exposed to dangerous concentrations of nitric fumes.

#### **A. Latent Period**

There is usually a latent period of 1 to 12 or more hours between exposure to lung-irritant gases and development of symptoms. Cigarette smoke is unpleasant during this period, but there may be no other indication that an individual has been gassed. This latent period often occurs after exposure to phosgene and may be longer than 12 hours; after exposure to chlorine, there may be none. After chlorpicrin, the latent period is short and may be less than an hour; after nitric fumes, it is long, like that of phosgene. Chlorpicrin may cause eye irritation and vomiting in addition to lung irritation.

Persons exposed to lung irritants must be kept quiet, after even slight respiratory symptoms have developed. After being placed at rest patients must lie quietly and not attempt to feed themselves or to sit up.

#### **B. Effects**

Lung irritants cause pulmonary edema, a water-logged condition of the lungs which may cause the victim literally to drown in his own body fluids which pour into the irritated lungs. It is difficult for the heart to force blood through the damaged lungs, and death may result from circulatory collapse if the patient does not "drown."

## **C. Symptoms**

There may be none for 12 to 24 hours after exposure, except that cigarette smoke is unpleasant. Examination of the chest by a physician reveals nothing abnormal. The patient then begins to breathe rapidly, becomes flushed and then bluish, and may develop a painful cough with swelling of neck veins (Blue Stage). He may cough up blood-tinged frothy sputum and appear to be strangling. He may develop circulatory failure and turn a greyish leaden color, become cold and clammy, as in shock (Grey Stage). After recovery from this, he is still in danger of developing bronchopneumonia.

## **D. First Aid**

1. Remove from the gaseous atmosphere and keep patient absolutely quiet in bed or on a stretcher. He must under no circumstances walk, or even sit up, even though he may feel perfectly well. Keep him warm with blankets and hot drinks, and get him to a doctor as soon as possible. He must not smoke; it may cause coughing, which is an additional strain on the heart.
2. Do not give artificial respiration to relieve difficult breathing in the blue or grey stages. It is indicated only if the patient has actually stopped breathing. The lungs are full of fluid and any additional manipulation may be fatal.
3. If symptoms appear, the patient should be given oxygen to breathe if available.

## **CHAPTER III—BLISTER GASES**

### **Mustard (HS)**

### **Lewisite (M-1)**

### **Ethyldichlorarsine (ED)**

Because of their ability to render an area uninhabitable for days, the blister gases are among the most important and effective chemical warfare agents. They are more liable to be used against a strategic civilian area than the lung irritants, which are quickly dissipated.

The blister agents are not true gases but are oily volatile liquids. They may be used as a bomb filling or may be discharged from an airplane as a fine spray which behaves as a gas. The liquid slowly vaporizes into a true gas. Both vapor and spray are heavier than air and tend to drift into and linger in cellars, ditches, and other low places.

Both liquid and vapor may irritate, burn, and blister any skin or mucous membrane with which they come in contact. Because of their persistence and insidiousness, blister agents cause many casualties, but the death rates are low. Only 2 percent of blister-agent casualties in the First World War were fatal.

#### **A. Special Characteristics**

##### **1. Persistence**

Under normal weather conditions in temperate climates, they may persist for days in an area sheltered from wind and sunlight. In winter they persist longer.

##### **2. Potency**

The power of these agents is so great that a drop the size of a pin head can produce a blister the size of a quarter. Exposure for 1 hour to air containing 1 part per million of vapor can cause a casualty. The eyes are particularly susceptible.

##### **3. Penetration of Materials and of the Human Body**

The blister agents “soak in” as ink soaks into a blotter.

This is not the same as “eating in” of an acid; the penetration takes place without damage to clothing. Because the

agents are highly soluble in fats, they also readily penetrate tissues. A drop of mustard on the skin glistens for about 2 minutes and then is absorbed. Only metals, glass, highly glazed tiles and porcelains, and specially-treated fabrics resist their penetration. The agents penetrate rubber slowly.

#### **4. Insidiousness**

Even in concentrations sufficient to cause burns, the presence of these agents, particularly mustard, may not be detected by odor or by any immediate irritation.

#### **5. Delayed Action**

Their ability to cause damage before any evidence of their presence is recognizable makes these agents dangerous. A patient may be sufficiently contaminated to cause extensive burns and show no signs of injury for 12 or more hours.

#### **6. Universal Action**

These agents burn and blister any tissue, on the surface or in the interior of the body, with which they come in contact. Their effects are not limited largely to one set of body structures as is the case with tear gases and lung irritants. Although the skin is most apt to be exposed, the lungs may be injured by breathing vapor and the stomach by swallowing contaminated food, water, or even saliva.

There are two types of blister agents:

- a. Those which cause only local surface irritation.
  - b. Those which also cause systemic (internal) poisoning.
- These usually contain arsenic.

More than any other type of chemical agent, the blister gases, especially those containing arsenic, will poison food and water, and render other supplies dangerous to handle until they have been decontaminated.

*Before transporting or treating blister-agent casualties, medical unit personnel must apply to themselves those individual or collective measures which are necessary for their own protection, or they will also become casualties.* A gas mask protects only the face, eyes, and lungs; protective ointment must be used on exposed parts and protective clothing worn where possible.

## **Table of Differences Between Lewisite and Mustard**

It is important to distinguish between mustard and lewisite burns because of the greater severity and danger of arsenic poisoning from lewisite.

	MUSTARD	LEWISITE
<b>Odor</b>		
<b>Persistence in Contaminated Area</b>		
Summer	4 or 5 days in open; 1 week in woods.	24 hours in open; 2 or 3 days in woods.
Winter	Several weeks. (At low temperatures lewisite is more volatile than mustard and is therefore more dangerous in cold weather.)	One week or more.
<b>Immediate effects</b>		
On skin	None, even from liquid.	Sharp tingling from liquid.
Nose	None.	Breathing vapor for a few minutes causes sharp burning irritation.
Eyes	None from vapor. Mild irritation from liquid.	Immediate severe pain from liquid.
<b>Skin Burns</b>		
	Itching; little pain. Blisters filled with clear fluid and surrounded by an area of erythema (redness).	Pain as well as itching; blisters filled with cloudy fluid. Little surrounding erythema (redness).
<b>Late Effects</b>		
Skin	Burns only skin.	Burns through skin into muscles.
Eyes	Severe inflammation but rarely scarring with loss of vision.	Inflammation more severe and usually causes some scarring and permanent impairment of vision.
Entire body	Produces no systemic (internal) poisoning.	Produces systemic poisoning with arsenic.

The effects of this group of chemicals vary with the portion of the body exposed. Signs and symptoms may be delayed, particularly with mustard. The length of the latent period depends on the concentration of the agent and on the individual sensitivity of the skin. *Prolonged exposure to concentrations barely detectable by odor will produce casualties.*

## **B. Mustard**

### **1. Effects**

In persons unprotected by masks, eye symptoms are generally the first to appear. These begin with smarting and watering of the eyes 2 or 3 hours after exposure to vapor, followed by reddening and swelling. There is considerable pain, especially from bright light, and swelling may completely close the lids. If liquid is splashed into the eyes, there is almost immediate burning and all symptoms develop more rapidly. Eye burns vary from simple irritation and redness following mild vapor to severe ulceration from liquid mustard.

Sneezing and running nose are also early symptoms.

Skin burns from vapor may not appear until 12 or more hours have elapsed, but may develop within 1 hour after contact with liquid mustard. The first symptom may be severe itching, followed by a sunburnlike redness, upon which small and large blisters develop. Shortly before the development of blisters, the surface of the reddened skin can be rubbed raw with slight pressure and friction. When liquid has been splashed on the skin, the blisters may be arranged in a ring around a central, whitish, indurated area. The blisters are surrounded by a zone of redness. Because of the depth of skin destruction, mustard burns may require some weeks to heal and may become infected.

Vapor burns are more severe on areas of the body covered by clothing, which interferes with the dissipation of the mustard, and also on those areas subject to friction where the skin is moist or thin. The elbow, knee, and neck folds, external genitalia, and armpits are particularly susceptible. The fluid contents of mustard blisters are not irritating to the skin.

Irritation of the lungs is first indicated by hoarseness followed by a harsh brassy cough, later followed by production of yellowish sputum. These cases are serious because bronchopneumonia may develop. This condition was responsible for most of the deaths from mustard gas during the First World War.

Stomach irritation with nausea and vomiting may result from swallowing contaminated food, water, or even saliva.

Figures A and B illustrate two stages of mustard burns. Figure A shows a blister 48 hours after contamination with liquid mustard and B the same area after two weeks.

## **2. Prevention—First Aid**

To be effective, treatment must begin within a few minutes after exposure. *Prophylaxis is effective only up to 5 minutes after liquid contamination.* It is of little value after exposure to vapor because in this form most of the agent has penetrated the skin before the person reports for treatment.

Contaminated clothing must be removed quickly, with proper precautions (mask, gasproof gloves, apron, protective ointment) to protect the attendant. Clothes must be placed in a covered metal container until decontaminated (Figure C).

Eyes exposed to liquid mustard should be immediately and thoroughly irrigated with a 2-percent solution of sodium bicarbonate (baking soda), or plain water. The solution should run directly into the eyes from any available container suitable for the purpose. The entire contents of a pitcher or water bottle should be used. *If irrigation cannot be instituted within a few minutes following exposure, it should not be done at all.* Eyes exposed to vapor need not be irrigated. If exposed to a fine spray, or if there is any doubt as to exposure of the eyes to liquid, irrigation should be performed as above. A 2-percent solution of butyn may be instilled in the eyes to relieve pain. *Cocaine must not be used; it may cause ulceration. The eyes must not be bandaged.*

Great care must be used in the removal of mustard from the skin; otherwise the agent will merely be spread. The steps are as follows:

- a. Gently apply dry pads to absorb any mustard remaining on the skin.
- b. Apply household bleach (containing 3 to 5 percent sodium hypochlorite) liberally to the contaminated area.
- c. Wash the skin surface thoroughly with soap and water within and beyond the margins of the contaminated area.
- d. Pat the area dry with a towel. *Do not rub.*
- e. Burn or bury the materials contaminated during the procedure. Keep away from the smoke while contaminated materials are burning; it may contain mustard vapor.



FIGURE A.—Blister following liquid mustard.



FIGURE B.—Same as figure A after two weeks.

Protective ointment (Chemical Warfare Service) also effectively removes mustard from the skin surface if it is applied with rubbing and then wiped off.

Products containing active chlorine, such as bleaching powder and commercial bleaching solutions, are most effective. Bleaching powder should be mixed with 1 or 2 parts of water. Dry bleaching powder may be used if water is not available, but the reaction with mustard will generate heat. Even so, the effect will be less than if mustard were left on the skin. Ordinary bleaching powder does not exceed 30 percent chlorine; high-test bleaching powder of 70 percent chlorine should never be used dry; reaction with mustard will cause burns. *If such products are not immediately available, time should not be wasted in looking for them.* Immediate, thorough washing with soap and water is effective.

Bleaching powder and solutions are irritating and must be removed from the skin as soon as possible (within a few minutes) or they will increase the burn. *Be sure to keep them out of the eyes.* If reddening of the skin indicates that the burn has already begun to develop *do not use these compounds; they will only increase the irritation.* It is preferable to apply antipruritic ointment (Appendix II, Item 8) to relieve the itching.

If it is likely that mustard has entered the mouth or nose, the mouth and nasal passages should be rinsed and the throat gargled repeatedly with 2 percent solution of sodium bicarbonate. The patient should be kept quiet and warm to guard against bronchitis and bronchopneumonia.

If nausea and vomiting indicate that contaminated materials have been swallowed, the stomach should be washed out by repeated drinking of warm 2 percent solution of sodium bicarbonate. This will induce vomiting and wash out the irritant.

After cleansing, all persons with eye, nose, and throat burns and with any but slight skin burns should be hospitalized. Skin burns must be treated surgically as any severe extensive burn.

## C. Lewisite

Lewisite is similar to mustard in physical characteristics but is more volatile and hence more effective in cold weather. It is also more immediately irritating and is

more dangerous because it contains arsenic. Water breaks it down into a solid oxide containing arsenic, which is also irritating and poisonous. This solid is extremely persistent; contact with ground which has been contaminated with lewisite will cause burns for a long time thereafter.

### **1. Early Effects**

Symptoms develop earlier and are more severe than with mustard. Liquid lewisite in the eye causes immediate pain. On the skin, redness appears within 15 to 30 minutes after contamination with liquid, and blisters soon appear, reaching their maximum within 12 hours. The entire area blisters, leaving no red margin around the blister as is usually observed in mustard burns. The blister fluid contains arsenic and is itself capable of causing burns and general poisoning.

### **2. Late Effects**

Lewisite burns are more painful and more dangerous than mustard burns. Lewisite in the eye may cause blindness. In addition to painful burns which may later become infected, symptoms of arsenic poisoning may appear. These are dryness and soreness of the throat, diarrhea, and restlessness. Later, paralysis of arm and leg muscles may develop.

Until neutralized or removed, lewisite continues to penetrate, burning through the skin into muscle or other body tissue. It differs in this respect from mustard, which never penetrates beneath the skin unless carried into a wound by contaminated shell or bomb fragments.

### **3. Prevention—First Aid**

#### **a. Eyes.**

Liquid lewisite in the eyes is an emergency. The eyes must be treated as indicated on page 12.

#### **b. Skin.**

To be really effective, *treatment must begin within 1 minute* after contamination with liquid lewisite. Contaminated clothing must be quickly removed, with precautions to protect the attendant, and treatment should be started while clothing is being removed. The contaminated areas should be swabbed immediately and repeatedly with hydrogen peroxide. Solutions with 10

or even 20 percent available oxygen are best, but are unstable. (Hydrogen peroxide must not be used in the eyes.) The ordinary 3 percent solution available in drug-stores will suffice. Lacking this, the technique described for liquid mustard must be used. Following treatment, the skin should be washed with soap and water and patted dry. *All contaminated cloths or sponges must be burned or buried.*

It is extremely urgent that patients contaminated with lewisite come immediately under medical treatment. The doctor must open the blisters as soon as possible to prevent further absorption of arsenic. In opening the blisters, he must be careful to prevent infection and must remember that the blister fluid itself is capable of producing burns.

## **D. Ethyldichlorarsine**

This compound may also be employed as a blister agent. It is less persistent than lewisite or mustard, lasting from 1 hour in the open in the summer to 12 hours in the woods in the winter.

### **1. Immediate Effects**

It is more irritating to nose and throat than lewisite or mustard. Immediate symptoms of sneezing and often vomiting are therefore common. It is less irritating to the skin and therefore less apt to blister. It is capable, however, of causing arsenic poisoning.

### **2. First Aid**

Immediate measures are the same as for lewisite. If vomiting is persistent, the stomach should be washed out by repeated drinking of warm 2-percent solution of sodium bicarbonate.

## **CHAPTER IV—TEAR GASES (LACRIMATORS)**

**Chloracetophenone (CN)**

**Chloracetophenone Solution (CNS)**

**CNB Solution (CNB)**

**Brombenzylcyanide (CA)**

These substances produce severe but temporary eye irritation. Permanent damage rarely results. Many other chemical warfare agents also irritate the eyes but require greater concentrations than the tear gases. The tear gases, however, may cause panic in an uninformed population that does not understand their relative harmlessness and the rarity of serious after-effects. Tear gases are not persistent, except brombenzylcyanide, which is as persistent as mustard.

### **A. Effects**

Exposure immediately produces spasm of the eyelids with sensitiveness to light, inability to open the eyes, copious tears, and some irritation of a freshly shaven face. Chloracetophenone solutions may cause a mild rash in warm weather and occasionally vomiting. If the solution itself gets into the eyes, there may be permanent damage.

### **B. First Aid**

The individual should be removed from the contaminated air and face the wind with eyes open. If irritation is marked, the eyes may be irrigated with boric acid or a 2 percent solution of sodium bicarbonate (baking soda). *The eyes must not be rubbed or bandaged.*

Skin irritation may be treated by sponging with a solution of 4 percent sodium sulfite in 50 percent alcohol. All symptoms usually disappear within an hour.

## **CHAPTER V—THE IRRITANT SMOKES (SNEEZE GASES OR STERNUTATORS)**

### **Adamsite (DM)**

### **Diphenylchlorarsine (DA)**

These agents are used to produce irritation of the nose, throat, and eyes, and are dispersed in clouds or smokes of very fine particles rather than as true gases. Their action is so delayed that symptoms may not appear until after the mask has been put on. When this occurs, an untrained person may think his mask unsatisfactory and remove it, becoming a casualty from further exposure. These agents are very insidious. They have no odor and are usually detected only when symptoms appear.

#### **A. Effects**

There is pain and a feeling of fullness in the nose and sinuses, accompanied by violent sneezing and running of the nose. Severe headache may develop, followed by burning in the throat and tightness and pain in the chest. Nausea and vomiting may occur, and eye irritation may produce a flow of tears. A striking peculiarity of these agents is the mental depression they induce. Severely gassed persons may attempt suicide.

#### **B. Diagnosis**

This is based on the presence of the symptoms just described, followed by relatively rapid recovery despite the miserable appearance and condition of the individual.

#### **C. First Aid**

Remove to pure air if possible. A nasal spray of pontocaine and neosynephrin gives relief (see Appendix II, Item 10). Inhalation of dilute chlorine from a small amount of bleaching powder in a wide-mouthed bottle or can is also effective. Headache may be controlled with 10 to 15 grains of acetylsalicylic acid (aspirin). There are no after effects and the individual recovers within a few hours.

Severely exposed individuals must be watched for suicidal tendencies. Continue to reassure them that their symptoms will be of brief duration and are not dangerous.

## **CHAPTER VI—INCENDIARIES**

### **Thermit—Molten or Burning Metal Oil White Phosphorus**

#### **A. Thermit and Oil**

Burns from molten metal are apt to be deep and severe due to the high temperature. Immediate first aid consists in flushing spattered globules of metal with large quantities of water to produce cooling. Flaming oil on clothing or skin must be smothered. Treatment is the same as for burns from any other cause.

#### **B. White Phosphorus**

This agent ignites by itself in the air when dry. Water or wet cloths will quench the fire, but as soon as the particle dries in air, it again begins to burn. The effect of particles on the skin is the same as that of any heat burn; they stick and burn until removed, or until air is excluded by covering with water or treating with copper sulfate (blue vitriol).

##### **First Aid**

Keep the burn wet with water or wet cloths until the particles can be squeezed or picked out. Warm water, about 40° centigrade (104° Fahrenheit), melts phosphorus and makes squeezing easier. If squeezing does not bring out the particles, they must be picked out with forceps. Do not use mud as formerly recommended; it may cause infection. Urine is sterile and is satisfactory if there is no other source of water.

Unless there is time and water is available for immediate treatment, apply a 5 to 15 percent solution of copper sulfate to the burn. This coats the phosphorus with copper phosphide, shuts out the air, and stops the burning until the particles can be removed.

After the phosphorus has been removed, further treatment is exactly the same as for any other heat burn, with the exception that *ESCHAROTIC* agents, particularly tannic acid, should not be used.

## **CHAPTER VII—THE SCREENING SMOKES**

### **Titanium Tetrachloride (FM) HC Mixture (HC) and Sulfur Trioxide-chlorsulfonic Acid Solution (FS) White Phosphorus (WP)**

These are used to screen positions or troop movements or to mask gas-cloud attacks with other agents. They do no damage in ordinary field concentrations, but may be dangerous in the heavy concentrations formed at the site of release. They are of practical concern, therefore, only to the military personnel, or to persons in the immediate vicinity of an exploding shell or bomb containing the agents.

#### **A. Titanium Tetrachloride, HC Mixture, and Sulfur Trioxide Solutions**

The liquids produce acid-like burns of the skin. The vapors are irritating and unpleasant to breathe, but are not dangerous. Spray in the eyes may cause serious burns.

##### **First Aid**

This consists in washing with large quantities of water. In the eyes, this should be followed by irrigation with a 2 percent solution of sodium bicarbonate (baking soda). If the irritation is severe, the patient must see a physician.

#### **B. White Phosphorus**

The smoke from white phosphorus is harmless, but particles from a shell explosion will cause burns and should be treated as described under incendiaries.

## **CHAPTER VIII—THE SYSTEMIC POISONS**

### **Hydrocyanic Acid and Hydrogen Sulfide**

#### **Arsine**

#### **Carbon Monoxide**

Although not immediately irritating to the skin, eyes, nose, or lungs, these agents cause systemic (internal) poisoning and, if inhaled in sufficient quantity, they may cause death. Hydrocyanic acid and hydrogen sulfide may be immediately fatal; arsine produces destruction of the red blood cells, which may result in death in a few days from kidney damage. Carbon monoxide, while not used as a war gas, may be encountered following breaks in illuminating gas mains.

### **A. Hydrocyanic Acid and Hydrogen Sulfide**

#### **1. Immediate Effects**

Odor of bitter almonds (hydrocyanic acid) or rotten eggs (hydrogen sulfide) may be noticed, but strong concentrations dull the sense of smell and the individual may be overpowered and collapse immediately. Weaker concentrations may produce headache, dizziness, and nausea.

#### **2. First Aid**

Anyone rendering first aid in a gassed area must be protected by a mask or he will also become a casualty. *Do not enter a gassed area to bring anyone out unless you wear a mask; you may not get out yourself.*

First aid consists in inhalation of amyl nitrite fumes and artificial respiration, until a physician can begin medical treatment. Artificial respiration should be continued for hours, even though it appears hopeless.

## **B. Arsine**

Odor of garlic and metallic taste are the only immediate effects. Persons exposed to arsine must be kept quiet, and hospitalized as soon as possible. Meanwhile, they should be given large quantities of alkalies such as sodium bicarbonate, citrate, or phosphate to drink. This alkalinizes the urine and may help to prevent coagulation in the kidneys of protein from the red blood cells destroyed by the arsine.

## **C. Carbon Monoxide**

This is the colorless, odorless constituent of automobile exhaust and artificial illuminating gases which causes many fatalities. It replaces the oxygen in the blood, and the victim is rapidly asphyxiated. It may be encountered in enclosures where fire has been burning with a limited air supply, in basements and tunnels where gas mains have been ruptured, and in other closed places.

### **1. Effects**

With high concentrations, the victim collapses without warning after breathing the contaminated atmosphere for a few minutes. Lower concentrations first cause headache and dizziness, followed by collapse.

### **2. First Aid**

Immediate removal from the contaminated atmosphere is most important. If breathing is shallow or has stopped, artificial respiration must be instituted and continued until the patient is breathing normally again. This may require some hours.

The casualty should be given oxygen to breathe as soon as it can be made available. *Do not wait for oxygen before starting artificial respiration.*

## **CHAPTER IX—GAS CLEANSING STATIONS**

Because of the persistent nature of blister gases, arrangements must be provided for their removal from clothing and skin of gassed persons with other injuries at special "Gas Cleansing Stations" (Fig. C). Persons contaminated with these agents must not be brought to Casualty Stations without first being cleansed.

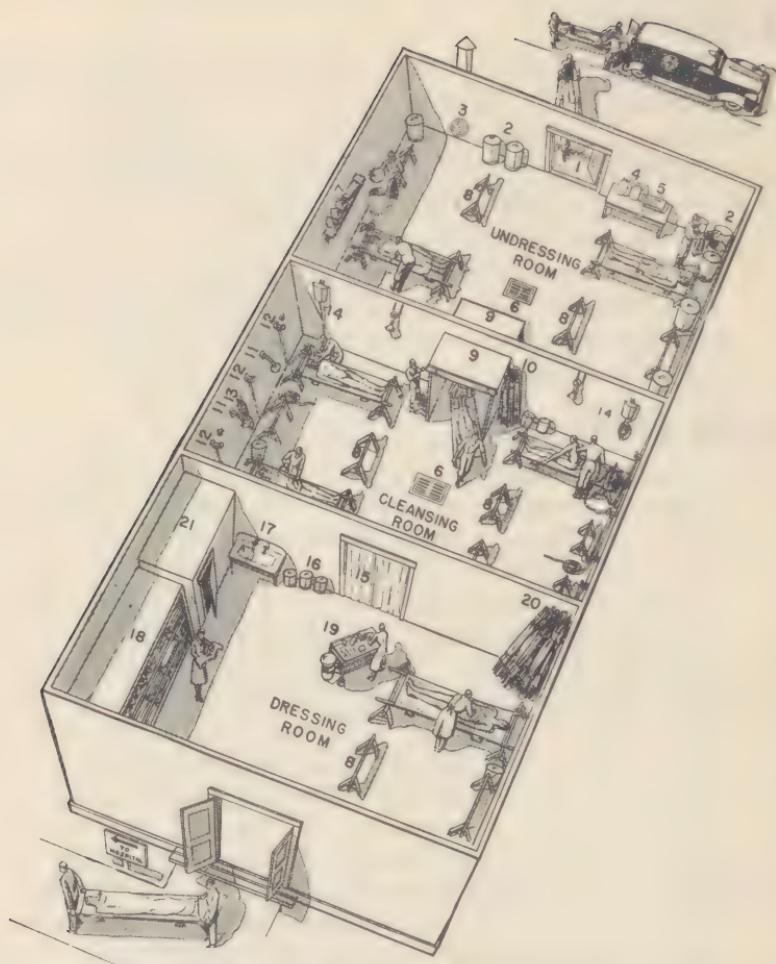
Gassed persons who are uninjured and able to help themselves should not waste time by going to gas cleansing stations, but should cleanse themselves in their own homes or at the nearest washing facilities (Appendix I).

### ***Steps in Cleansing***

Stretcher bearers and injured persons who are still ambulatory, presumably masked, walk through a box for the decontamination of shoes as they enter with the patients. This box is filled with bleaching powder and dirt mixed in the ratio of 1 scoop of bleach to 2 of dirt. This proportion is proper for the usual bleaching powder with 30 percent chlorine. If bleach with a different chlorine content is used, the proportions of bleach and earth should be adjusted accordingly. Inasmuch as contaminated materials are being brought into this room, an exhaust fan near the floor is provided, and masks and protective clothing are worn by the permanent attendants. Clothing is removed and deposited in covered receptacles, by an attendant whose duty it is to undress stretcher cases. If the stretcher has been contaminated, the casualty must be shifted to a clean one. The individual then sponges himself or is sponged by the attendant with hydrogen peroxide, or with solutions containing active chlorine, as described in the text. The contaminated sponging materials must also be deposited in covered receptacles.

The casualty next goes through a gas lock to the shower room, where provision must be made for irrigation of the eyes and for thorough bathing with soap and water. The gas lock, the ends of which are closed with blankets, must afford space for the admission of a stretcher with bearers. Again an attendant is on duty with a spray for bathing stretcher cases.

Finally, the patient is taken to the dressing and first aid room, where there is a physician in attendance for care of the wounded. The wounded may be evacuated from this room to the hospital by ambulance.



1. Box of sand and bleaching powder for decontamination of shoes.
2. Containers for contaminated clothing.
3. Exhaust fan near floor.
4. Bottles of sodium hypochlorite.
5. Pan of sodium hypochlorite solution.
6. Floor drain.
7. Containers for valuables.
8. Stretcher supports (saw horses).
9. Gas lock.
10. Used and possibly contaminated stretchers.
11. Shower heads for cleansing operating personnel.
12. Hose and connections for cleansing injured patients.
13. Containers for sterile solution for irrigation of wounds.
14. Eye irrigators.
15. Curtained entrance to dressing and first aid room.
16. Containers of sand and bleaching powder.
17. Sink with hot and cold water.
18. Cabinet for storage of equipment such as masks, protective clothing, sheets and clean clothing.
19. First aid cart.
20. Clean stretchers.
21. Toilet.

FIGURE C. Diagram of a Gas Cleansing Station Suggesting a Suitable Arrangement of Facilities.

## **ADDENDUM**

### **Nitrogen Mustards**

A series of new war gases known as the nitrogen mustards may be encountered in the event of gas attacks on the civilian population.

Some of these agents are odorless and others have very faint fishy or soft soap-like odors. It is likely that they will be identified only by chemical means or by their blistering and eye effects. The nitrogen mustards are similar to ordinary mustard in that they are persistent blister gases.

The effects of these agents on the body are similar to those of ordinary mustard, except that injury to the eyes may be more severe; skin burns appear sooner but are less severe. Irritation of the lungs is similar to that produced by ordinary mustard.

Civilians, gas masks and protective clothing protect against the nitrogen mustards. In the event of exposure to these agents, the eyes should be irrigated immediately, and not later than 5 minutes, with a 2% solution of sodium bicarbonate or plain water. After blotting off any excess of the liquid agent, the skin should be washed thoroughly with large amounts of soap and water. Protective ointments and household bleaching solutions are not as effective against these agents as they are against ordinary mustard.

The same precautions should be observed for nitrogen mustards as are recommended for other blister gases.

## **APPENDIX I**

### **How to Protect Yourself Against Gas**

The following information is supplied because of the possibility that gas may at some time be used by the enemy. If people will remember a few simple facts, they should have no unreasonable fear of this agent.

1. Most war gases tend to stay close to the ground, for they are heavier than air. To get out of a gassed area, simply walk against the wind or go inside a building.

2. Gas is irritating and annoying to the eyes, nose, lungs, or to the skin, but it is usually harmless if you do not be-

come panicky but promptly leave the gassed area and cleanse yourself. A soldier must put on a mask where it is necessary to remain in the contaminated area, but a civilian can go inside and be relatively safe if the windows are kept closed.

3. If the gas should get on your skin, you can prevent it from doing much harm by sponging it off as quickly as possible with a piece of clothing, such as a handkerchief, and applying some neutralizing substance, followed by a thorough bath, preferably a shower, with common laundry soap and water.

4. If you are indoors, stay there with doors and windows closed, and go up to the second or third story. Stay out of basements. Turn off the air conditioning, and stop up fireplaces and any other large openings.

5. Some gases are spread as oily droplets which blister and burn the skin and eyes. If you are outside when gas is used do not look up. Tear off a piece of clothing or use a handkerchief to blot any drops of liquid from your skin and throw the contaminated cloth away. Blot; do not rub, as rubbing will spread the liquid. Then go home, if it is nearby, or to the nearest place where you can wash immediately with soap and water and cleanse yourself in the following manner:

a. Remove all outer clothing outside the house, since gas can be transmitted to others from contaminated clothing. Put it preferably in a covered garbage pail.

b. Apply one of the following effective household remedies to the part of your skin that has been contaminated; household bleach containing 3 to 5 percent sodium hypochlorite (for mustard); peroxide of hydrogen (for lewisite); paste or solution of baking soda if you have no peroxide or bleach. If you do not know the gas, use both peroxide and bleach. Keep bleach and peroxide out of the eyes. *Do not waste time looking for these remedies*; bathe immediately if they are not at hand.

c. After entering the house, wash the bleach or peroxide from hands with soap and water and then wash the face. Remove the underclothing, place it in a covered container, and enter the bathroom.

d. Irrigate the eyes with large amounts of lukewarm 2 percent solution of baking soda (one tablespoonful to a quart of water), or else with plain water. Use an ordinary irrigating douche bag or an eye irrigator. If you do not

have these, let plain warm water pour into the eyes from the shower, washing them thoroughly. Do not press or rub the eyes.

- e. Lastly, take a shower, using soap and hot water.
- f. If the nose and throat feel irritated, wash them out also with baking soda solution.
- g. If your chest feels heavy and oppressed, if you have any trouble breathing, or if cigarette smoke becomes distasteful, lie down and stay perfectly still until a doctor sees you.
- h. If blisters develop, be careful not to break them. A physician will be needed.

### **Remember:**

Soldiers require gas masks because they must remain in the contaminated area. Civilians can get out of the gassed area or go indoors where they usually do not need gas masks or protective clothing.

Injured persons who are gassed require cleansing before they can be admitted to hospitals. All other civilians can best prevent any serious injury by promptly helping themselves in the manner outlined, using a kitchen or bathroom, soap and water, and a few materials found in every household.

## **APPENDIX II**

### **Recommended Contents of Special First Aid Chest for Gas Casualties**

1. Bleaching powder—30%	2 lbs.												
2. Protective ointment—3-oz. tube	10												
3. Hydrogen peroxide—10% available oxygen	1 qt.												
4. Sodium hypochlorite (3 to 5%)	1 qt.												
5. Soap	6 cakes												
6. Sodium bicarbonate (baking soda)	5 lbs. (Two teaspoonsful per pint make 2% solution)												
7. Butyn N. N. R. 3 gr. hypo. tablets, 10 tablets per vial	2 vials												
8. Antipuritic ointment for mustard burns	3 ounces <table><tbody><tr><td>Benzyl alcohol</td><td>50%</td></tr><tr><td>Stearic acid</td><td>30%</td></tr><tr><td>Glycerin</td><td>10%</td></tr><tr><td>Ethyl alcohol</td><td>8%</td></tr><tr><td>Pontocaine</td><td>1%</td></tr><tr><td>Menthol</td><td>1%</td></tr></tbody></table>	Benzyl alcohol	50%	Stearic acid	30%	Glycerin	10%	Ethyl alcohol	8%	Pontocaine	1%	Menthol	1%
Benzyl alcohol	50%												
Stearic acid	30%												
Glycerin	10%												
Ethyl alcohol	8%												
Pontocaine	1%												
Menthol	1%												

9.	4% solution sodium sulfite in 50% alcohol . . .	8 ounces
10.	Neosynephrin hydrochloride 1% . . . . .	4
	Pontocaine hydrochloride . . . . .	04 . . . 2 ounces
	Boric acid saturated solution . . . . .	12
11.	Acetylsalicylic acid (aspirin) 5-gr. tablets . . .	100
12.	Copper sulfate (blue vitriol) . . . . .	1 lb.
13.	Amyl nitrite U. S. P. Ampules—5 min . . .	2 doz.
14.	Absorbent cotton . . . . .	1 lb.
15.	Enema can and tube for irrigating eyes. . .	1

## **Uses of Recommended Agents**

1. For cleansing of skin from blister agents; for inhalation following irritant smokes.
2. For protection of skin and cleansing following blister agents.
3. For removing lewisite from skin.
4. For removing mustard from skin.
5. Following Nos. 3 and 4.
6. a. For eye irrigation following blister gases, tear gas, or other chemical agents.  
b. For washing nose, throat, and stomach following blister agents.  
c. For drinking after arsine exposure.
7. For preparing solution to relieve pain in eyes from mustard and lewisite.
8. To relieve itching following mustard burns.
9. For removing tear gases from skin.
10. For nose spray following irritant smokes.
11. For headache following irritant smokes.
12. For phosphorus burns.
13. For hydrocyanic acid poisoning.

# SUBJECT INDEX

	<i>Page</i>
Adamsite, irritant smoke . . . . .	18
identification . . . . .	4
Antipruritic ointment for itching from mustard . . . . .	14
formula (appendix II, item 8) . . . . .	27
Arsenic, blister gases. . . . .	19
blister fluid . . . . .	15
ethyldichlorarsine . . . . .	16
lewisite. . . . .	15
poisoning . . . . .	15
Arsine, systemic poison . . . . .	21
alkalis in treatment . . . . .	22
identification . . . . .	5
Artificial respiration, dangers after lung irritants . . . . .	7
in systemic poisons . . . . .	21, 22
Aspirin following irritant smokes . . . . .	18
Baking soda for arsine . . . . .	22
ethyldichlorarsine . . . . .	16
eyes . . . . .	12
mustard . . . . .	14
nose and throat . . . . .	14
screening smokes . . . . .	20
tear gases . . . . .	17
vomiting . . . . .	14, 16
Blankets in gasproofing gas cleansing stations . . . . .	23
rooms . . . . .	5
Bleaching powder, chlorine content . . . . .	14
dry, heat from . . . . .	14
decontamination of shoes . . . . .	23
eyes, keep out of . . . . .	14
irritant smokes . . . . .	18
mustard, neutralizes . . . . .	14
skin irritation from . . . . .	14
Blister, lewisite . . . . .	15, 16
mustard (Figures A, B) . . . . .	13
nitrogen mustards . . . . .	25
Blister gases, Chapter III . . . . .	8
Blue Stage, lung irritants . . . . .	7
Blue vitriol, for phosphorus burns . . . . .	19
Brombenzylcyanide, tear gas . . . . .	17
identification . . . . .	4
Bronchitis, after mustard . . . . .	14

	<i>Page</i>
Bronchopneumonia, after lung irritants . . . . .	7
after mustard . . . . .	11, 14
chief cause of death from mustard . . . . .	11
Burns, eyes . . . . .	11, 12, 15, 20, 25
lewisite . . . . .	15
molten metal . . . . .	19
mustard (Figures A, B) . . . . .	13
white phosphorus . . . . .	19, 20
skin (Figures A, B) . . . . .	11, 13, 15, 19, 25
Carbon monoxide, systemic poison . . . . .	21
artificial respiration for . . . . .	22
oxygen for . . . . .	22
Chloracetophenone, tear gas . . . . .	17
identification . . . . .	4
Chlorine, lung irritant . . . . .	6
identification . . . . .	4
Chloropicrin, lung irritant . . . . .	6
identification . . . . .	4
Cigarette smoke, unpleasant after lung irritants . . . . .	6, 7
Citrate, sodium, for arsine . . . . .	22
Cleansing of skin, lewisite . . . . .	15
mustard . . . . .	12
Clothing, contaminated . . . . .	12, 23
penetration by blister agents . . . . .	8
protective against blister agents . . . . .	9
CNB, tear gas . . . . .	17
identification . . . . .	4
Copper sulfate for white phosphorus . . . . .	19
Decontamination of shoes (Figure C) . . . . .	24
Death, blister agents . . . . .	8
lung irritants . . . . .	6
mustard . . . . .	11
systemic poisons . . . . .	21
Depression, mental, from irritant smokes . . . . .	18
Diphenylchlorarsine, irritant smoke . . . . .	18
identification . . . . .	4
Edema, pulmonary, from lung irritants . . . . .	6
oxygen for . . . . .	7
Ethyldichlorarsine, blister gas . . . . .	8, 16
identification . . . . .	4
Eyes, lewisite, effects . . . . .	15
treatment . . . . .	15

	Page
Eyes, mustard, effects . . . . .	11
treatment . . . . .	12
nitrogen mustards . . . . .	25
tear gas . . . . .	17
Fan, exhaust, for gas cleansing station (Figure C) . . .	24
First aid chest, contents (appendix II) . . . . .	27
Gas cleansing station, Chapter IX, Figure C . . . . .	23, 24
Gas lock . . . . .	23
Grey Stage, lung irritants . . . . .	7
Headache, after irritant smokes . . . . .	18
after systemic poisons . . . . .	21, 22
aspirin for . . . . .	18
HC mixture, screening smoke . . . . .	20
Hydrocyanic acid, systemic poison . . . . .	21
Hydrogen peroxide, after lewisite, skin . . . . .	15
Hydrogen sulfide, systemic poison . . . . .	21
Identification, table of agents . . . . .	4
Incendiaries, Chapter VI . . . . .	19
Irritant smokes, Chapter V . . . . .	18
Lewisite, blister gas . . . . .	8, 14
distinction between lewisite and mustard. . . . .	10
Lung irritants, Chapter II . . . . .	6
Lungs, edema from irritants . . . . .	6
irritation from mustard . . . . .	11
irritation from nitrogen mustards . . . . .	25
Mental depression from irritant smokes . . . . .	18
Mustard, blister gas . . . . .	8
effects and first aid . . . . .	15
mustard, distinction from lewisite. . . . .	10
Mustards, nitrogen . . . . .	25
Nausea, from mustard . . . . .	11, 14
irritant smokes . . . . .	18
Neosynephrin spray for irritant smokes . . . . .	18
formula (appendix II, item 10). . . . .	28
Nitric fumes, lung irritant . . . . .	6
identification . . . . .	4
Nitrogen mustards. . . . .	25
Odor, identification of agents by . . . . .	4
table . . . . .	4
Ointment, protective . . . . .	9
for cleansing of skin . . . . .	14
Oxygen, for pulmonary edema . . . . .	7
for carbon monoxide . . . . .	22
Paralysis, from arsenic in lewisite . . . . .	15

	Page
Phosgene, lung irritant . . . . .	6
identification . . . . .	4
Phosphate, sodium, for arsine . . . . .	22
Phosphorus, white, incendiary . . . . .	19
screening smoke . . . . .	20
Pontocaine, spray for irritant smokes . . . . .	18
formula (appendix II, item 10) . . . . .	28
Protective ointment . . . . .	9
for cleansing of skin . . . . .	14
Pulmonary edema from lung irritants . . . . .	6
oxygen for . . . . .	7
Screening smokes, Chapter VII . . . . .	20
Skin burns, lewisite . . . . .	15
mustard (Figures A, B) . . . . .	11, 13
phosphorus . . . . .	19
cleansing, mustard. . . . .	12
lewisite . . . . .	15
protection against . . . . .	9
tear gas . . . . .	17
Sneeze gases, irritant smokes . . . . .	18
Sniff sets . . . . .	3
Soda, see baking soda	
Sodium bicarbonate, see baking soda	
citrate, for arsine . . . . .	22
hypochlorite . . . . .	12
phosphate, for arsine . . . . .	22
sulfite, for skin irritation with tear gases . . . . .	17
Suicidal tendencies, after irritant smokes . . . . .	18
Sulfur trioxide, screening smoke . . . . .	20
Systemic poisons, Chapter VIII . . . . .	21
Table, distinction between lewisite and mustard . . . . .	10
identification of agents by odor . . . . .	4
Tear gases, Chapter IV . . . . .	17
Titanium tetrachloride, screening smoke . . . . .	20
Urine, alkalinization for arsine . . . . .	22
on phosphorus burns . . . . .	19
Vomiting, after chlorpicrin . . . . .	6
ethyldichlorarsine . . . . .	16
irritant smokes . . . . .	18
mustard . . . . .	11, 14
tear gas . . . . .	17
White phosphorus . . . . .	19, 20







**U. S. Government Printing Office, Washington, D. C.**

**For sale by Superintendent of Documents, Price 10 cents**